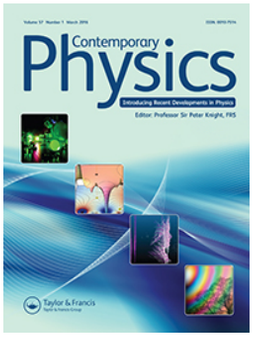

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Vibrations, 3rd edition

by Balakumar Balachandran and Edward B. Magrab, Cambridge, UK, Cambridge University Press, 2018, 723 pp., £87.99 (hardback), ISBN: 9781108427319. Scope: textbook, reference. Level: undergraduate, advanced undergraduate, postgraduate, teacher, engineers

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BOOK REVIEW

Vibrations, 3rd edition, by Balakumar Balachandran and Edward B. Magrab, Cambridge, UK, Cambridge University Press, 2018, 723 pp., £87.99 (hardback), ISBN: 9781108427319. Scope: textbook, reference. Level: undergraduate, advanced undergraduate, postgraduate, teacher, engineers

Oscillations are ubiquitous in nature, and as such constitute a fundamental field of study of physics. Vibrations can be understood as small oscillations around an equilibrium position, and play an important role in science and engineering. Even though we can observe vibrations in many different disciplines, mechanical vibrations were the first to be studied, based on physical principles and rooted in the science of mechanics. Furthermore, its relevance is enormous in the context of the different applications in engineering. Vibratory systems may appear in different engineering devices and systems such as mechanical, aerospace, naval, automobile, electromechanical, biomechanical, and as well as in civil structures.

As a consequence of the above, the study of the physics of vibration is fundamental in the syllabus of a physicist or an engineer. Certainly, there are great books on the subject matter as the well-known *Vibrations and Waves* by A. P. French, or *Physics of Vibration* by A.B. Pippard, *Mechanical Vibrations* by William W. Seto or *Fundamentals of Mechanical Vibrations* by S. G. Kelly. The present book *Vibrations, 3rd Edition* has been designed by two professors of Mechanical Engineering of the University of Maryland to provide basic and more advanced techniques of vibratory systems oriented towards applications in engineering and physical sciences useful to teach the basic principles for undergraduate and postgraduate students. At the same time to illustrate the applications of these basic principles to numerous disciplines, and to understand the physical principles underlying the dynamics of vibrations and its applications. The book succeeds in integrating linear systems and some models of nonlinear systems, vibration analysis in the time domain and the frequency domain, responses of systems to harmonic and transient excitations, and discrete and continuous system models. It contains a rich blend of analysis, modelling, measurement, prediction, and design.

Among the issues this third edition of the book excel, I would mention the numerous figures and simulations as interactive graphics available for the students for exploring the dynamics of the different vibratory systems, that suppose an aid for the understanding of the basic ideas. As what concerns the structure, each chapter contains numerous examples with excellent illustrations on applications to real problems of engineering, beyond mechanical vibrations, that definitely strongly contribute to better understand the application of principles of vibrations at various length scales, including micromechanical and biomechanical systems. Excellent tables with very nice figures summarise the explained material at the end. Every chapter ends with a summary showing the main objectives to learn. Besides the numerous examples, that could be considered as solved exercises, a large collection of exercises also with good illustrations of the mechanical vibratory systems enrich the book; and answers to some selected exercises appear at the end of the book in an appendix. A collection of Appendices reviewing basic concepts of elementary mechanics and some mathematical tools such as Laplace transforms, ordinary differential equations, and other mathematical tools also constitute a helpful aid for the better use of the book.

The book is organised into nine chapters, with the topics covered ranging from pendulum systems and spring-mass-damper prototypes to beams. Chapter 1, basically introduces the subject matter and provides a historical overview of the subject. In Chapter 2, the basic elements that are used to construct a vibratory system model are introduced and discussed, such as inertia, stiffness and damping, including different damping models. Chapters 3, 4, 5 and 6 are devoted to single degree-of-freedom systems, where the equations of motion, the free-response characteristics, the response to periodic excitations and to transient excitations respectively, are addressed. The equations of motion are calculated by using force and moment balance methods as well as using Lagrange's equations. Ideas of nonlinear systems are also discussed, either as a way to later use linearisation techniques or even systems with nonlinear damping. Multiple degree-of-freedom systems are treated in Chapters 7 and 8 leading up to systems with an infinite number of degrees of freedom in Chapter 9, where the subject of beam vibrations is treated at length. The methodology used in these last chapters is based in what has been explained in the first chapters, though some extra mathematical tools are required that actually are reviewed in the appendices.

The contents of the book are organised in such way that it can be used for a standard course on vibrations for undergraduate students, where some prerequisites on dynamics and on ordinary differential equations is assumed. There is sufficient advanced material for a graduate course as well. In any case, it would be helpful to make a wise selection of the topics depending on the level and duration of the course. It could also be very useful as a source reference for lecturers in physics of vibrations and mechanical vibrations for engineering, as well as a reference book for engineers.

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