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BOOK REVIEW

PRINCIPLES OF VIBRATION, 2002, by B. H. TONGUE. Oxford: Oxford University Press, second edition, x + 518 pp. Price £29.99, US$105.00. ISBN 0-19-514246-2

I have never met Professor Tongue, but having read his Principles of Vibration feel I know him well! This somewhat unusual vibration textbook has been explicitly written for the student rather than for the teacher. This makes it very readable if somewhat chatty. Once one gets used to the informal American style, it is indeed very readable and many of the explanations and illustrations given are exemplary. There are inevitably a few places where the explanation seems unnecessarily laboured and others where the reader is asked to take things on trust, or prior knowledge is assumed, but on balance the level of explanation seems about right for the target readership. New cartoons based on Dopey dog add a little amusement.

The basic content is unchanged from the first edition, although it is longer by 54 pages and also uses a slightly smaller typeface. The text follows the traditional route from free vibration of single-degree-of-freedom systems in the first chapter, to forced vibration and shock response in the next two. Knowledge of Newton's laws and free body diagrams is assumed, as are courses on dynamics, deformable bodies and linear algebra. The discussion of Lagrange's equations at the end of Chapter I is quite useful (although it introduces forces in a chapter dealing with free vibration). The complex exponential is introduced part way through Chapter 2, although it is used briefly without explanation on page 7! This seemed unnecessary as the solution to the differential equation could have been written directly in terms of sine and cosine functions without recourse to exponentials.

The longest chapter (120 pages) is on multi-degree-of-freedom systems, and is conveniently based from the start on matrix methods. Vibration absorbers are introduced as a way of illustrating a two-degree-of-freedom system. Eigenvectors and normal forms, proportional damping and forced response of damped systems are all covered in detail. This is followed by a short chapter introducing (one-dimensional) distributed systems which concentrates on extensional motion of a rod and bending of a beam. Chapter 6 covers approximate methods: Rayleigh's quotient, Rayleigh–Ritz and assumed modes methods.

A short chapter with the catchy heading "Seat-of-the-pants engineering" describes approximate methods for determining natural frequencies of complex systems and for use in checking models. As the text says, this is material which is intuitive to those who have been doing it for long enough, but it is seldom taught. The final chapter is on experimental methods and real-world behaviour. This includes the response to random loading, spectral analysis and a brief introduction to experimental modal analysis, although this deals with the associated measurements rather than with modal analysis as such. A final subsection introduces the implications of non-linearity by an illustrative example.

There are a total of 82 worked examples in the text. Simple Matlab examples are also included and these will be useful to help the readers to develop understanding where it is available to them. Many example graphs are also included which illustrate well the principles involved. A minor complaint is that, all graphs are based on linear axes. Since

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much additional insight can be gained by viewing frequency response functions on logarithmic scales, it is unfortunate that this is not included at all.

An impressive set of “homework problems”, 516 of them in all, linked to each chapter provide a useful resource for the teacher as well as good practice for the student. These have been considerably expanded and revised since the first edition. However, the answers to selected problems have been omitted from this edition—for these the reader must refer to the author’s website.

Only 12 references are included plus a list of 11 vibration textbooks (some of which are also in the list of references). This is in keeping with the tutorial rather than learned reference nature of the book. A new section entitled “Just the facts” has been added at the end containing 73 key equations. This is a useful revision tool and could be used as an additional index if page numbers or equation numbers from the main text were included.

The first edition came packaged with a spring to be used in making demonstrations. The various demonstrations are still included in the book and this no doubt adds greatly to the learning experience, although the reader has to be prepared to cut his spring in half in Chapter 4. The spring has unfortunately been omitted from the second edition, as “sadly too many people were ripping the springs out of the packaging”. However, they are apparently available to instructors from the publisher.

SI units are used throughout. Frequencies are based only on rad/s; there is no mention of Hz except in an example in Chapter 7. Damping is almost completely considered as viscous, which at least keeps things simple. A short section is included in Chapter 2 on other types of damping, introducing dry friction and hysteretic damping. This was found to be a little unsatisfactory to someone used to working with loss factors; for example, it would have been useful to point out that at resonance the loss factor is twice the equivalent viscous damping ratio.

Finally a quote, almost at random to give a little of the flavour: “The sin and the cos terms give us the “wiggle” in our solutions, while the sinh and the cosh give us solutions that get large quickly as x increases.”

D. J. THOMPSON