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Book Reviews

Theory and Problems of Dynamic Structural Analysis. by J. J. Tuma and F. Y. Cheng, McGraw-Hill, New York (Schaum Outlines), 1983, 234 pages. Price: $9.95 (Paperbound)

Reviewed by H. Saunders

Recently, a number of books on structural dynamics have been published. This book is unique among them since it presents information on stiffness, flexibility, and transport (transfer) matrices. The book, although brief, does present a number of interesting applications. It contains 195 solved problems. As stated by the authors, "This book . . . was prepared to serve as a college outline in the first standard course in structural dynamics. The book may be used in a formal course or as a supplement to all current texts on the subject. The numerous solved problems with conclusions underlying the major points of solutions constitute the best means of understanding the basic principles."

Chapter 1 presents the basic ideas of dynamics employed in structural analysis. It includes Newton's law, virtual work and mention of Lagrange's and Hamilton's equations.

Chapter 2 delves into single-degree-of-freedom systems. It considers mechanical and Hookean models, free and forced vibration (with and without damping), the Kelvin model and introduction to the transport (transfer) matrix. The Dirac delta function is employed in solution of an impulsive load.

Chapter 3 continues with systems of several degrees of freedom. This includes free and forced vibration (with and without damping), properties of natural modes, and modal analysis. The section on transport matrix concludes the chapter.

Chapter 4 focuses upon energy methods. These encompass the equations for generalized forces (spring, damping, and applied loads), and derivation of the Lagrange equation. The chapter concludes with small accelerations and oscillations in generalized coordinates utilizing potential, kinetic, and dissipation energies. A number of solved problems show the use of these concepts. The reviewer feels that a more detailed and application problem discussion of Hamilton's principle is in order.

Chapter 5 delves into matrix methods. The authors show how the transport, flexibility, and stiffness matrices are derived. These are implemented in lumped mass systems accompanied by a number of excellent worked out examples. The relation between the transport (transfer) matrix and stiffness matrix should have been derived and explained.

Chapter 6 continues with distributed mass systems. This embraces free and forced longitudinal vibration of a finite straight bar and free and forced transverse vibrations. This chapter contains excellent tables for a number of loading conditions on simple beams. The worked-out examples explaining forced vibration are excellent.

Chapter 7 extends the information of the previous chapter by digging into distributed mass systems. This contains the solutions of differential equations of free and forced vibration introduced in Chapter 6 applied to secondary effects, i.e., on an elastic foundation and on beam columns. The Timoshenko beam is next examined and accompanied by solutions shown for various end conditions.

The next chapter deals with the assembly of beam columns and longitudinal and transverse vibrations of beams in transport matrix form. The novel inclusion of the closed form of transport matrix coefficients expressed by MacLauren's and matrix coefficients is a definite plus. This is rarely seen in books on structural dynamics.

Chapter 9 explains the concepts of dynamic flexibility and stiffness methods. The flexibility and stiffness coefficients are tabulated in nondimensional forms with worked-out examples. One of the novel features of this chapter is the solution of the three moment equations in closed form using the slope deflection in both the flexibility and stiffness matrices.

The last chapter reports upon vibration of variable cross-section members. Beginning with the differential equations of varying section bars and beams, consideration is given to lumped and stepped mass and substitute function methods. All these are represented in matrix forms accompanied by well-explained examples.

In summary, this is a good book. However, the reviewer believes that a number of topics and features should be added. A table with nomenclature should be included since the symbols in this text are not the same as those commonly used in other texts. Additional examples should be incorporated showing how finite elements are collected and used. Substructuring as applied to dynamics and a discussion of modal analysis might also be incorporated. Shock response might also be included.

The reviewer further recommends that the authors consider writing an advanced text on structural dynamics.

The reviewer feels that this book is a bargain considering its contents. The book is recommended to the neophyte as well as to experienced personnel interested in structural dynamics.

Structural Mechanics Software Series (Vol. IV). by N. Perrone and W. Pilkey (Eds.), University of Virginia Press, Charlottesville, VA, 1982, 467 pages. Price: $25.00

Reviewed by H. Saunders

This fourth volume keeps the standards high. The first