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book reviews

An Introduction to Thermomechanics. By H. Ziegler. North Holland Publishing Co., Amsterdam, The Netherlands, and New York. 1977. Pages xii–308. Price $35.95.

REVIEWED BY D. E. CARLSON[1]

This is an introductory text which should be accessible to beginning graduate students and most seniors in the mechanically based branches of engineering. While the reviewer would prefer, especially for an introduction, a more pedantic style which clearly delineates between primitives, definitions, axioms, theorems, and proofs, the conversational tone adopted here has proven to be more generally palatable to both students and teachers; and it is predicted that *An Introduction to Thermomechanics* will enjoy the same wide acceptance as Professor Ziegler's other books.

The first three chapters, on mathematics, kinematics, and kinetics, are based on Prager's *Introduction to Mechanics of Continua.* The next two chapters are concerned with thermodynamics and material properties. Chapters 6–11 are brief treatments of ideal liquids, linear elasticity, inviscid gases, viscous fluids, plasticity, and viscoelasticity. Chapters 12 and 13, on general tensors and large displacements, are fashioned after *Theoretical Elasticity* by Green and Zerna. Chapters 14 and 15 are devoted to a presentation of Ziegler's own notion of thermodynamic orthogonality and its immediate consequences. Finally, the last three chapters provide second looks at non-Newtonian fluids, plasticity, and viscoelasticity in light of the orthogonality principle.

Of course, the thermodynamical aspects of thermomechanics are still fraught with controversy, and there are even strong opinions on how best to develop the generally accepted mechanical aspects of the subject. The author has wisely chosen to present his views directly without criticism of or comparison to other approaches. However, the reviewer did notice several slips which transcend the realms of controversy and taste. In the development of stress, Cauchy's lemma (Newton's third law of action and reaction) is tacitly assumed. In the development of heat conduction, it is directly assumed that the heat flow per unit area is the inner product of the heat flux vector and the surface normal. This is analogous to starting with the stress tensor and then assuming that it operates on the normal to produce the stress vector. The concept of material frame-indifference does not appear at all in the book. Finally, both the printing and binding of the review copy were poorly done.

Integral Equation Methods in Potential Theory and Elastostatics. By M. A. Jaswon and G. T. Symm. Academic Press, London. Pages xi-287. Price $21.15.

Reviewed by T. A. CRUSE[2]

Application of integral equation techniques to solving significant engineering problems is a recent development, although the mathematical bases are quite classical. So-called (boundary) integral equation techniques show distinct advantages to other numerical techniques for many problems through reduction of the volume (area) problem to a numerical solution for boundary data only. The authors of this important monograph were among the early developers of such integral equation-based, numerical solutions for potential theory applications. The monograph strongly reflects the research interests of the authors, with liberal reference to the rapidly expanding variety of other, related research. While the authors state that the material contained in the monograph "should be of direct use to engineers," this reviewer must, unfortunately, disagree.

The authors have chosen to restrict their material almost without exception to the use of scalar potential functions, even for the problems of elastostatics. Such restriction makes it difficult for the engineer who is most usually familiar with the direct vector formulations of elasticity, except by broad reading of the relevant references, thereby defeating the purpose of the monograph. Further, the authors make extensive and, in the opinion of this reviewer, obfuscating use of dyadics for the vector potential function formulations. Such use of dyadic notation, while perhaps elegant, is not in congruence with the common notation used in the literature of integral equation research. Thus notation is a further burden on the potential user of the technology reported in this monograph.

The monograph is also disappointing from a more mathematical standpoint as well. Major differences in the numerical solution for boundary data exist between indirect potential methods (use of artifical surface density functions) and direct potential methods (use of physical boundary conditions) when the boundary is nonsmooth. The classical basis of integral equation theory is for the indirect potential method applied to smooth surfaces; the modern applied integral equation methods use the direct potential method which may be routinely applied to nonsmooth boundaries. The authors demonstrate these differences numerically without a clear delineation of the fundamental formulational differences; thus the reader is left with no foundation upon which to base his/her own research.

In spite of these limitations, this reviewer commends the monograph to the applied mechanics community for its clarity and its emphasis on the numerical solution portion of the (boundary) integral equation method. The material is concisely and logically presented in two parts: Theory, and Applications; these may be read almost independently. Individual chapters in the first part include basic potential theory, integral equation formulations using single and double-layer potentials, boundary integral equations, and two-dimensional elasticity (plate bending and stretching). The second part includes a basic discussion of numerical models with two-dimensional applications to the Dirichlet and Neumann problems, steady-state heat conduction and torsion problems, and to the biharmonic problem. Finally, brief numerical results to some three-dimensional problems are given.

Helicopter Dynamics. By A. R. S. Bramwell. John Wiley-Halsted Press. 1976. Pages viii–408. Price $38.50.

REVIEWED BY P. P. FRIEDMANN[3]

This book represents the accumulated engineering experience of its author in dealing with a variety of helicopter aerodynamic and dynamic problems. It is a very useful and timely addition to the field,

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