Journal of Applied Mechanics

Book Reviews

Mathematical Models in Applied Mechanics, by A. B. Tayler. Oxford University Press, New York, 1986. 280 Pages. Price: $29.95/cloth; $14.95/paper.

REVIEWED BY J. B. KELLER[1]

This very readable book is concerned primarily with the formulation of mathematical models of physical phenomena, especially in mechanics. It teaches modeling by example, using twenty-two typical problems which have arisen from industrial research. In each case it explains the physical background of the situation and then shows how to formulate a mathematical problem to model it. This is followed by some mathematical analysis of the problem, with the purpose of illustrating some important features of the solution.

All of the mathematical models involve partial differential equations. They are grouped into three chapters on hyperbolic, elliptic, and parabolic problems, respectively. These chapters are preceded by one which describes nondimensionalization, some perturbation procedures, some methods for solving ordinary differential equations, and some basic equations of fluid dynamics and elasticity. A final chapter presents asymptotic methods for nonlinear problems, such as boundary layer and ray methods. Each chapter ends with a set of exercises.

The variety of problems is great as the following selection indicates: Pantograph dynamics, coal seam exploration, flow of granular material, electrochemical painting, percolation in a sand dune, hot rolling of steel, smoke dispersion from a chimney, welding of two steel plates, spreading of an oil film, injection moulding, seismic detection.

The book can be read by anyone with some knowledge of differential equations and mechanics. It could be used as a text for a course on modeling or as a supplementary text for a course on partial differential equations. Since the presentation is lively and informal, it is a pleasure to read just to learn about a large number of interesting applications.

[1]Professor, Mathematics Department, Stanford University, Stanford, CA 94305.

Solid Mechanics Research for Quantitative Non-Destructive Evaluation, edited by J. D. Achenbach and Y. Rajapakse. Martinus Nijhoff Publishers, The Netherlands, 1987. 438 Pages price: $122.00.

REVIEWED BY A. K. GAUTESEN[2]

This book contains the proceedings of the ONR Symposium on Solid Mechanics Research for Quantitative Non-Destructive Evaluation (QNDE) which was held at Northwestern University in September, 1985. Here, the state of the art in QNDE was reviewed along with the methods and techniques being investigated at the time.

With the advent of modern technology it has become possible to detect very small inhomogeneities in materials by nondestructive evaluation procedures. Since some of the detected inhomogeneities will not affect the serviceable life of the material, the need has arisen for more quantitative information about the inhomogeneity—such as location, size, shape, and orientation. This need has given birth to a more fundamental and rigorous approach called QNDE. Disciplines spanned by this approach include mechanics of solids, materials science, electrical engineering, applied physics, applied mathematics, and computer science. Although significant progress has been made, QNDE is still in its infancy and fundamental deficiencies exist in many areas. This field continues to be the focus of intense research.

This book is organized into nine chapters. In Chapter 1, R. deNale and D. E. Chimenti describe requirements in QNDE for the Navy and Air Force, respectively. In Chapter 2, H. N. G. Wadley discusses the use of acoustic emission as a QNDE technique for the study of fracture; and W. Sachse summarizes the application of quantitative acoustic emission measurements for the investigation of dynamic fracture processes and for the characterization of materials and transducers. In Chapter 3, J. D. Achenbach reviews some aspects of flaw characterization by ultrasonic scattering

[2]Senior Mathematician and Professor of Mathematics, Dept. of Mathematics and Ames Laboratory, Iowa State University, Ames, IA 50011.