

THE FINITE ELEMENT METHOD WITH HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS

This book is intended for advanced undergraduate and graduate students. The first four chapters are devoted to introduction of the finite element concept. The focus of the book then covers two essential areas – heat transfer and fluid mechanics – topics with different finite element formulations. The heat transfer applications begin with the classical one-dimensional thin-rod problem, followed by a discussion of the two-dimensional heat transfer problem, including a variety of boundary conditions. Finally, a complicated-geometry three-dimensional problem involving a cooled radial turbine rotor is presented, with the cooling passages treated as “heat sinks” in the finite element analysis. For fluid mechanics, the concept of “nodeless” degrees of freedom is introduced, with real-life fluid flow applications. The time-dependent finite element analysis topic is addressed through the problem of unsteady stator/rotor flow interaction within a turbomachinery stage. Finally, the concept of “virtually deformable finite elements,” as it relates to the problem of fluid-induced vibration, is explained in detail with many practical applications.

Erian A. Baskharone is Professor Emeritus of Mechanical and Aerospace Engineering at Texas A&M University. He is a member of the ASME Turbomachinery Executive Committee. Dr. Baskharone was a senior engineer with Allied-Signal Corporation, responsible for the aerothermodynamic design of various turbofan and turboprop engines. His research covered a wide spectrum of turbomachinery topics, including the unsteady stator/rotor flow interaction and the fluid-induced vibration of the space shuttle main engine turbopumps. His finite element-based perturbation approach to the problem of turbomachinery fluid-induced vibration is well known. At Texas A&M, he received the General Dynamics Award of Excellence in Engineering Teaching (1991) and the Amoco Foundation Award for Distinguished Teaching (1992). He is the author of *Principles of Turbomachinery in Air-Breathing Engines* (Cambridge University Press, 2006) and *Thermal Science: Essentials of Thermodynamics, Fluid Mechanics and Heat Transfer* (2012).