DEVELOPMENTS IN THE DESIGN
OF THERMAL SYSTEMS

Thermal systems are essential features in power, chemical processing, air conditioning, and other industries where heat and power are used. As the cost and complexity of designing thermal systems have increased, the need to understand and improve the design process has also grown. This book describes recent progress in the design of thermal systems.

The book begins with a brief history and outline of developments in thermal system design. Chapters then discuss computer design tools for the power and chemical industries, predicting physical properties with computational tools, the use of pinch analysis to improve thermal efficiency, applications of the exergy concept, the emerging concept of thermoeconomics, and the potential for artificial intelligence and expert systems in the design of thermal systems.

With chapters written by internationally recognized authorities, the book offers a state-of-the-art review for both researchers and practitioners in mechanical, aerospace, chemical, and power engineering.
DEVELOPMENTS IN THE DESIGN
OF THERMAL SYSTEMS

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Preface

This book is a milestone in the presentation of developments in techniques used to design thermal systems. On these pages is an overview of current practice in this rapidly developing field.

With roots tracing to the use of Second Law ideas for design applications decades ago, the design of thermal systems has advanced quickly in the last 20 years. The many computational tools now available make it possible to evaluate virtually all aspects of the performance of systems, from overall behavior to the details of each of the component processes. Every aspect of these types of analysis has seen significant accomplishments.

What has not been done previously is to summarize the cutting-edge trends in this field – the aim of this book. Drawing on the work of people from around the world, the book gives a good cross section of progress made to date.

Designers of thermal systems are practitioners from a variety of disciplines. Although the major contributors and users have been chemical and mechanical engineers, many others find the approaches that have been developed to be of great value. It is not unusual to find a symposium taking place on a regular basis somewhere in the world on issues related to this field.

The book starts with an outline of the major industrial thrusts that have shaped design interests in thermal systems. Summaries are then given of design trends in both the power industry (Chapter 2) and the chemical process industry (Chapter 3). Significant impacts of the rapid strides experienced in computer technology are in evidence here. Equally important is the ability to predict material properties, and Chapter 4 summarizes how this is done in modern codes. Pinch analysis, a technique that has been shown to be valuable in efficiently allocating energy in new systems, as well as in modifying existing ones, is given in Chapter 5. Applications of exergy, a concept that is an outgrowth of Second Law ideas and has become important in the design process, are summarized in Chapters 6 and 7. Topics in thermoeconomics and the application of artificial
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intelligence, which have been less fully developed as design tools at this time, are described in Chapters 8 and 9, respectively.

I particularly wish to thank the authors. They are busy but have taken the time to summarize carefully the key areas of this field. The definitive insights set down by these experts make this book valuable to people involved in the design of systems.

I also greatly value the assistance of Florence Padgett, editor at Cambridge University Press, in this effort. She appreciated the need for a monograph in this area. Also, she obviously has been involved with many efforts of this sort, because she understood all the excuses when deadlines slipped.

Robert F. Boehm
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Robert M. Privette earned his B.S. and M.S. degrees in mechanical engineering, having received the latter from Purdue University in 1986. He has more than 10 years of experience in hydraulic and thermal-hydraulic systems. He has worked in the U.S. defense and power generation industries and is currently employed by Babcock & Wilcox (B&W) in their Research & Development Division in Alliance, Ohio. With B&W he has done experimental research related to nuclear production reactors and has managed the Power Systems Evaluation Section, which used process simulation software to evaluate and design various power generation systems. He currently manages a demonstration program for ten-kilowatt solid oxide fuel cell systems and evaluates new technologies of interest to B&W and its parent company, McDermott International.

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Biographical sketches of the authors

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