Book review

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***Energy Optimization in Process Systems*,**
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This book applies optimization approaches found in second law analysis, finite time thermodynamics, entropy generation minimization, exergoeconomics and system engineering to simulation and optimization of various energy processes. The book promotes systematic thermoeconomic methodology and its underlying thermodynamic and economic foundations in various physical and engineering systems. It is a modern approach to energy systems which applies methods of optimization and thermal integration to obtain optimal controls and optimal costs, sometimes in the form of certain potentials depending on the process state, duration and number of stages. The approach, which is common for both discrete and continuous processes, derives optimal solutions from mathematical models coming from thermophysics, engineering and economics. It deals with thermodynamic or thermoeconomic costs expressed in terms of exergy input, dissipated exergy, or certain extensions of these quantities including time or rate penalties, investment and other economic factors.

The first goal (Chapters 3-10) requires searching for limiting values of some important physical quantities, e.g. limiting power, minimum heat supply, maximum final concentration of a key component, etc. The second goal (Chapters 8 and 11), perhaps the most practical, applies profit or cost analyses to find economically (or exergo-economically) optimal solutions. The third goal (Chapters 12-20) pursues optimal solutions assuring the best system integration. Optimizations towards energy limits arise in various chemical and mechanical engineering systems (heat and mass exchangers, thermal networks, energy converters, recovery & storage units, solar collectors, separators, chemical reactors, etc.). Associated energy problems are those with conversion, generation, accumulation and transmission of energy. These problems are treated by mathematical methods of optimization such as: nonlinear programming with continuous and mixed variables, dynamic programming and Pontryagin's maximum principles, in their discrete and continuous versions. The considered processes occur in a finite time and in equipment of finite dimension. Penalties on rate and duration and optimal performance criteria of potential type (obtained within exergy or economic approaches) are effective.

The book fills a gap in teaching the process optimization and process integration in energy systems by using scientific information contained in thermodynamics, kinetics, economics and systems theory. Despite numerous works on energy and process integration in real systems (of finite size), appearing regularly in many research journals, no synthesizing treatment linking energy systems optimization with process integration exists so far in the literature. In this book, optimization problems arising in various chemical and mechanical engineering systems (heat and mass exchangers, thermal and water networks, energy converters, recovery units, solar collectors, and chemical separators) are discussed. The corresponding processes run with conversion, generation, accumulation and transmission of energy or substance, and their optimization requires advanced mathematical methods of discrete and continuous optimization and system integration. The methods commonly applied are: nonlinear programming, dynamic programming, variational calculus and Hamilton-Jacobi-Bellman theory, Pontryagin's maximum principles and methods of process integration. Synthesis of thermodynamics, kinetics and economics is achieved through exergo-economic and thermo-kinetic approaches generalizing classical thermodynamic approaches by taking into account constrained rates, finite sizes of apparatus, environmental constraints and economic factors.

While nonlinear programming, optimal control and system integration techniques are basic mathematical tools, this book addresses applied energy problems in the context of the underlying thermodynamics and exergoeconomics. The book can be used as a basic or supplementary text in courses on optimization and variational calculus, engineering thermodynamics and system integration. As a text for further research, it should attract engineers and scientists working in various branches of applied thermodynamics and applied mathematics, especially those interested in the energy generation, conversion, heat and mass transfer, separations, optimal control, etc. Applied mathematicians will welcome a relatively new approach to the theory of discrete processes involving an optimization algorithm with a Hamiltonian constant along the discrete trajectory. They should also appreciate the numerous commentaries on convergence of discrete dynamic programming algorithms to viscosity solutions of Hamilton-Jacobi-Bellman equations.

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