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Systems and Controls

Introducing Systems and Control. By D. M. Auslander, Y. Takahashi, and M. J. Rabins. McGraw-Hill Book Company, New York. 1974. 389 pages. $13.50.

REVIEWED BY W. L. GARRARD[1]

This book is written as a text for introductory courses in systems and control for undergraduate engineering students. Such courses are intended to introduce the concepts of dynamic input-output models, state variables, feedback, dynamic stability, and frequency response. More specifically, students are expected to develop some facility for formulating lumped parameter models of simple, dynamic systems and for determining the time and frequency response of first and second-order systems.

Typically the approach taken in such introductory courses is to consider only linearized, single input-single output systems; consequently, a great deal of emphasis is placed on analysis techniques based on the Laplace transform. In general, rather standard mechanical and electrical and to a lesser extent hydraulic, pneumatic, and thermal systems are treated, and although analog computation may receive some emphasis, digital computation is often slighted. Thus the student who does not take additional courses in systems and control is left with a rather narrow perspective.

The current book presents a broader and more modern view of system dynamics. The authors emphasize the state variable approach and consider a wide variety of examples ranging from the standard spring-mass-dashpot system to biological systems. Nonlinearities are introduced early and digital computation is stressed; however, analog computation and the standard tools of linear analysis receive adequate treatment.

Some of the flavor of the book is given by a brief review of the chapters. In Chapter 1, the basic concept of dynamic input-output models, system decomposition, and feedback are well defined. The idea of state variable representation is introduced in Chapter 2 and resistive, capacitive, and inductive elements are discussed. In Chapter 3, the concept of modeling systems by sets of differential equations is introduced and several nonlinear examples are provided. Phase-plane analysis is discussed and linearization and the standard vector-matrix formulation of the linear state equations is introduced. Digital and analog solution of the state equations is presented in Chapter 4 and a good engineering oriented discussion of computational errors is given. In Chapter 5, the analytical solution of the free and forced linear state equations is treated and eigenvectors and eigenvalues are introduced. The Laplace transform is presented in Chapter 6 and scalar and matrix transfer functions are discussed. In general this chapter is good; however, the authors have not given a clear statement of conditions under which the final value theorem is valid. In Chapter 7, the idea of feedback control is developed and a number of examples are discussed. Frequency response is discussed in Chapter 8 and Nyquist and Bode plots are introduced. Chapter 8 is not limited to linear systems; however, and the frequency response of a system governed by Duffing's equation and the effects of relay type nonlinearities are included. In Chapter 9, the topic of discrete time systems and digital control is discussed, and in Chapter 10, random processes are briefly introduced.

The authors recommend that Chapters 1-8 be covered in a one-quarter course and the whole book be covered in a one-semester course; however, the last two chapters are so abbreviated as to provide only the flavor of discrete systems and random processes. Although the book contains many topics which are often considered too advanced for a first course, the authors have done an excellent job of using heuristic arguments and physical examples to present this material at a level which should be comprehensible to the typical junior engineering student. The book also treats traditional topics well and should provide an excellent text for introductory systems courses.

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