N. Harris McCLAMROCH, *State Models of Dynamic Systems : A Case Study Approach*, Springer Verlag, New York, 1980, viii + 248 pages, Hard Cover, DM 34.

The purpose of the book is to expose undergraduate students to the use of applied mathematics as a basis for developing an understanding of the response characteristics of a broad class of physical dynamical systems. It was written for use in a course followed by students in computer science and electrical engineering. These were familiar with differential equations, Laplace transforms, elements of physics, mechanics and circuits. The reader is expected to be likewise.

The subject matter of the book can be considered as an introduction to the theory of mathematical systems. A number of physical processes are examined where the underlying systems concepts can be clearly seen and grasped. Even though no attempt is made to present a general theory, the ultimate idea is that many of the important systems concepts (model, state, time invariance, approximation, simulation, feedback, stability, ...) are made clear. As the title suggests, the emphasis is on the state models for systems. This means that the systems can be expressed in terms of ordinary differential equations. It is certainly a draw back of this approach that the generality of certain concepts are not illuminated. Many other interesting models are only briefly considered. At the end of a chapter, a number of exercises are given. No hints are provided. Finding out the method of attack and the level of difficulty is part of the exercise.
The book can not be read and comprehended quickly or easily. The effort to master the material is considerable. As he mentions in the preface of the book, it is the author's experience when he taught the material that the most common source of difficulty is the synthesis of physical argument and purpose with mathematical formalism. The development of the ability for arriving at this synthesis is the main objective of the book.

A first introductory chapter gives a situation sketch of the modeling problem, some physical principles and a few elementary systems concepts. The second chapter, like all of the following chapters, gives a short introduction of the elements from system theory that are to be introduced by the case studies that follow. For chapter 2 this are first order linear state models, i.e., systems which require only one state variable. Four case studies are given (radioactive decay, temperature in a building, an RC-circuit). Chapter 3 gives case studies for second order linear systems. Here four examples can be found (metabolism of a drug, mixing of a salt solution, DC motor, bridged-T-filter). For the higher order systems, 5 examples are found in chapter 5 (reduction of limestone by heating, vertical ascent of a deep sea diver, a speedometer mechanism, a loudspeaker). The same scenario is followed for nonlinear systems in the next three chapters : first order - second order - higher order systems. The case studies for first order are : management of a fisheries resource, liquid level in a leaky tank, high temperature oven and a circuit with a diode. For second order : motion of a boat

crossing a river, spread of an epidemic, tunnel-diode circuit, underwater launch of a rocket, a study of blood sugar and insuline levels with application to diabetes. For higher order models : continuous flow stirred tank chemical reactor, a hot air balloon, motion of a rocket near earth and the electrostatic microphone.
In two final chapters, some other models are considered. Chapter 8 is about other differential state models (feedback control of a liquid level in a tank, automatic regulation of temperature in a building and sampled control of a field actuated motor) and chapter 9 gives discrete time models (occupancy in a hospital unit, an inventory model, neuron model, coin operated dispenser, a binary communications channel and a discrete population model).
A number of appendices give some useful information like appendix A which contains a table with units and conversion factors which is really helpful because of the interdisciplinarity of the examples. Appendix B gives some elements of Laplace transforms and a brief table. Appendix C discusses the Routh-Hurwitz stability criteria, and appendix D gives some ideas about linear approximants. Digital computer simulations and CSMP (a simulation language : Continuous System Modeling Program) is introduced in appendix E. A reference list of 74 items and an index conclude the book.

If the book is not used as a course text, i.e., as it was originally concepted, then it is still an interesting reading subject because contains a lot of practical examples that can be used to illustrate more classical approaches to system theory.

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