



book reviews

MATHEMATICAL MODELS, by Richard Haberman, Prentice-Hall, Inc., Englewood Cliffs, N. J.

REVIEWED BY ROBERT W. KOLKKA¹

The text *Mathematical Models* is the result of the author's construction of a first course in applied mathematics at Rutgers University. Mechanical vibrations, population dynamics, and traffic flow were chosen to illustrate the application of mathematics. The treatment of each area is entirely self-contained, and requires no previous exposure to any of the physical content of the material. A knowledge of a standard calculus sequence and ordinary differential equations is presupposed, but certain critical aspects are reviewed. In each of the three areas the major emphasis is on the nonlinear aspects of the phenomena.

The treatment of mechanical vibrations is basically that which can be found in the first few chapters of any standard "physics" text on classical mechanics.² Newton's laws are presented in the usual manner with the common misconception that the law of moment of momentum is a subsidiary derived principle, arising from the rate of change of linear momentum coupled with the existence of pairwise equilibrated forces (prob. 14.4 in text). The spring-mass systems and pendulum problems are presented in full enlightening detail, much more so than in any standard text on the subject. The nonlinear systems are emphasized and analyzed by phase plane methods. The phase plane method presented differs from the standard treatments in that it is complete. Important points such as, for example, distinguishing between isoclines and solution curves, are well clarified. In my opinion, as one who studies rational mechanics (yes, classical mechanics is still alive, well, and living at Lehigh University), the treatment of the pendulum problem is excellent. Comparison (of the phase plane methods) to other methods such as the "Liapunov direct method," etc. are unfortunately omitted, perhaps due to level of presentation and the author's orientation as an "applied mathematician."

The mathematical models presented in the section on population dynamics are crude (for those Biologists interested in the text), but they have to be as such, as the author explains in substantial detail. Discrete models are presented, in light of which sections on solving constant coefficient difference equations, both first and second order are set forth in a very straightforward fashion. Continuous models are also used, both density dependent and logistic. Mutualism, competition, and predator-prey models are analyzed in the phase plane in much the same manner as were mechanical systems. The stability analysis presented in this section is quite good, points such as the destabilizing influence of time delays are illustrated.

The approach to traffic flow is that of the continuous one-dimensional model which is contained in a book by G. B. Whitham.³ The treatment here is presented in great detail (135 pages

as opposed to 12 pages in Whitham's book), as an example, the author consumes sixteen pages to develop $(\partial\rho/\partial t) + \partial/\partial x (\rho u) = 0$, where ρ is of course, the density and u the velocity field. Functional relations between the velocity field and density field proposed, and compared with actual data from the Merrit Parkway and Lincoln Tunnel. Steady state car following models are discussed. The most important part, in view of engineering science is that the equation, $(\partial\rho/\partial t) + C(\rho)(\partial\rho/\partial x) = 0$, is discussed in total entirety; linearization and the consequences thereof are examined. The method of characteristics is examined thoroughly, with a detailed discussion of shocks. Inclusion of problems, such as; after a traffic light turns green, uniform traffic stopped by a red light, and effect of traffic being stopped momentarily, helps elucidate matters.

The overall presentation is greatly enhanced by the inclusion of innumerable figures and illustrations throughout the book. The book serves its purpose well, and it should be noted that although the techniques are developed in light of the chosen topics, they apply to many facets of engineering science. Systems analysis in population dynamics is exactly the same as it is in engineering controls, and traffic flow serves as an excellent introduction to gas dynamics.

AUTOMATIC CONTROL SYSTEMS, by Richard M. Phelan.

REVIEWED BY S. H. JOHNSON⁴

The books reviewed for this *Journal* are usually in print and some have been for years. In this case a publisher has provided the journal with a galley proof copy of a yet-to-be-released textbook on classical control system design. The book review process does not readily accommodate either such a document or the publishers hope that a review will promptly appear in the journal. There are two difficulties. The only compensation granted the reviewer is the copy of the book reviewed. A proof copy is considerably less compensatory than the final hardbound volume. Reviewers are usually slow as is the entire process. It is not uncommon for a year to elapse from reviewers receipt of a book to publication of a review. There is also a shortcoming from the reader's point of view: from a proof copy, no judgments can be made concerning appearance, paper and printing quality, or physical construction. The most noteworthy attribute of one recently reviewed book was that its pages fell out after modest use. The above notwithstanding, a review follows.

This book is described by the publisher as being, "a revolu-

¹Graduate Student, Lehigh University, Dept. of M.E.-Mech., Bethlehem, Pa.

²For example, Fowles, G. R., *Analytical Mechanics*, 2nd ed., Holt, Rinehart, Winston, 1970.

³Whitham, G. B., *Linear and Nonlinear Waves*, New York, John Wiley & Sons, 1974.

⁴Associate Professor of Mechanical Engineering and Mechanics, Lehigh University, Bethlehem, Penn.

Find out information about Automated Control Systems. Automatic control is widely employed in many technological and biological systems to perform operations not feasible for a man because of the necessity of processing a large amount of data in a limited time; it is also used to increase the productivity of labor and the quality and accuracy of regulation and to free men from controlling systems that operate under conditions which. Automatic Control Systems. Lecture-1 Introduction. Dr. Yehia EL Mashad TA: Eng. Ahmed Ü Abdelalim. Automatic control theory. A Course. used for analyzing and designing. automatic control systems. Brief history of automatic control (I). Automatic Control " Control means measuring the value of controlled variable of the system and applying the manipulated variable to the system to correct or limit the deviation of the measured value from a desired value. Definitions. Input or Set point or reference. IEEE Robotics and Automation Award. Robots. Industrial robot Autonomous research robot Domestic robot. General purpose. Home automation Banking automation Laboratory automation Integrated library system Broadcast automation Console automation Building automation. Specific purpose. Automated attendant Automated guided vehicle Automated highway system Automated pool cleaner Automated reasoning Automated teller machine Automatic painting (robotic) Pop music automation Robotic lawn mower Telephone Abstract This book presents general problems of Automatic Control Theory as a base of aircraft control systems research and design. It consists of two parts: Continuous Control Systems and Digital Control Systems. Emphasis is on the theoretical aspects of control systems. The items are arranged alphabetically according to author, with no attempt at classification. The first section includes all topics and the second section lists only articles which have English translations. Automatic Control Systems - Part I: Block Diagrams and Transfer Functions. Instructor: Shih-Min Hsu, Ph.D., P.E. 2012. In recent years, control systems have gained an increasingly importance in the development and advancement of the modern civilization and technology. Figure 1-1 shows the basic components of a control system. Disregard the complexity of the system, it consists of an input (objective), the control system and its output (result).