predicted quantitatively and qualitatively for a wide range of inputs. For this reason even inherently nonlinear systems are often approximated by linear models. Thus a book on the mathematical theory of linear systems, written for engineering students, must steer a difficult course.

Brown's volume is well organized. It treats such mathematical topics as differential equations, Fourier analysis, Fourier and Laplace transforms, and singularity functions and such system topics as stability and feedback. Somewhat more advanced work is discussed in the concluding chapters: Wiener-Lee optimization, discrete time functions, and sampled data systems. The material covered is the core of linear system theory; Brown's writing is clear and demands only a modest mathematical background.

Still, something is wrong. Brown is writing a book for all engineers, but by making the discussion independent of particular applications, he has to some extent made it independent of all applications. By writing from the position of a mathematician, he does not exploit the physical intuition and motivation of the engineer. To the engineer, linear system theory is as much a point of view as it is a branch of mathematics; unfortunately, this point of view is not developed.

The book's strongest feature is that it combines otherwise scattered material in an easily understandable form. However, the serious student of linear systems will still prefer to consult those other sources.

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The Long Cycle

Wildlife's Ten-Year Cycle. Lloyd B. Keith. University of Wisconsin Press, Madison, 1962. xvi + 201 pp. Illus. $6.

The Matamek Conference (1931) represented the first organized recognition on this continent of an old idea: that many of the mammals and birds of the North undergo more or less regular fluctuations in abundance. In 1942 Elton published a monumental study of cycles, *Voles, Mice and Lemmings*; he felt then that causal analysis lay 20 or so years in the future. Some 10 years later Cole created something of a sensation when he claimed that many or all of the available data were inadequate to convince the objective student of their reality [*Journal of Wildlife Management* **15**, 233 (1951); **18**, 107 (1954)]. Keith's book owes its existence largely to these prior events. Its timing, although suggestive, does not warrant the drawing of conclusions.

Keith assembles, surveys, and attempts to analyze the existing evidence for the "long" cycle that allegedly occurs in the larger game and furbearing animals. In collecting much previously inaccessible information, he provides a real service. The uninitiated has some surprises in store. Perhaps his first shock will come when he learns that the best single criterion for the existence of this 10-year cycle is that the average period between successive peaks must be more than 5 years The nature of the evidence is such that conclusions must be highly tentative. Perusal of the multitude of tables is more likely to lead to despair or a belief in numerology than to an understanding of what is going on. Aside from the well-known and remarkable fluctuations of fur returns from the lynx, the best data stem from a few small areas where populations of ruffed grouse and snowshoe hares have been estimated rather intensively for periods of 17 years or less. There are several other cases where regional correlations and concordances between fluctuations in different species are suggestive. There are also instances where fluctuations must be regarded as random.

The critical reader will wonder to what extent data selected to show cycles are admissible evidence for the existence of such cycles. He will, however, also be struck by the many firsthand, subjective accounts of periodicities. Aside from presenting the data and such pieces of analytical information as are available, Keith contents himself with a summary of the theories that have been invoked to explain the phenomena, in the evident belief that the time for synthesis has not arrived.

There are really two partly separate problems: the large fluctuations as such, and their periodicity. Even for the shorter and more frequently studied mouse cycles, causal explanations are far from adequate. What is needed, as Keith points out, is a sustained and concerted study for perhaps 20, perhaps 50, or more years. Quite apart from the difficulties of milieu, ecological research, in our society, is unlikely to get done in this way. If this is an indictment, few areas of human endeavor can escape it.

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Applied Mathematics

Advanced Engineering Mathematics. Erwin Kreyszig. Wiley, New York, 1962. xvii + 856 pp. Illus. $10.50.

Kreyszig's *Advanced Engineering Mathematics* is intended to introduce students of engineering and physics to those fields of mathematics which, from the modern point of view, seem to be most important with respect to practical problems. No mathematical background beyond elementary calculus is required.

Two topics receive the most attention —ordinary differential equations and complex analysis—but the book also includes chapters on the Laplace transformation, vector analysis, line and surface integrals, matrices and determinants, Fourier series and integrals, partial differential equations, and special functions. The author's effective scheme for treating numerical analysis is to discuss numerical methods as they are needed in many parts of the book rather than in a separate chapter.

To facilitate the use of parts of the book, the chapters are kept as independent of each other as possible. At the beginning of each chapter the author lists the chapters that are prerequisites, the sections that may be omitted in a shorter course, and an up-to-date set of references.

The book is well written, and both the exposition and the extensive sets of problems reflect a balance between mathematical theory and emphasis on applications. The book is a suitable textbook for a three- or a four-semester course, or, by omitting certain sections, it can be used for a shorter survey course. It can also be used for separate one-semester courses in several areas. It is an excellent reference book for engineers and furnishes a handy guide to the more commonly used mathematical theory, with references to more detailed treatments for those that are interested.

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