Book Reviews

ACTIVE AND NONLINEAR WAVE PROPAGATION IN ELECTRONICS

by Alwyn Scott

During the last 100 or so years, considerable attention has been focussed on the topic of nonlinear wave propagation. This attention has been largely confined to the disciplines of applied mathematics, fluid mechanics and more recently to plasma physics. The rapid development of tunnel and Gunn diodes, masers and lasers and an understanding of signal propagation on nerve axons has brought an increased awareness of this problem to the electrical engineering community.

Professor Scott, who has made many contributions to this topic over the last several years, has summarized and presented many of the techniques which are applicable to nonlinear wave propagation problems in a very readable and understandable introductory textbook. An underlying theme of the text is that many phenomena in nonlinear wave propagation can be modeled with one dimensional transmission lines consisting of distributed nonlinear and active elements. This modeling also helps the reader see some unity to what may at first glance appear to be a hodgepodge of elegantly derived mathematical results which are couched in the parochial terminology of a foreign discipline. For a person with a background in electrical engineering, this text is an excellent introduction to an interesting and very general topic.

The text discusses such topics as stability analysis, linearization techniques of Van der Pol and Kryloff and Bogoliuboff, phase space techniques, transient effects and steady state conditions. An extensive list of references is provided which allows the reader to easily find the original work. A number of well chosen problems are also given to illustrate the material.

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THEORY OF IONOSPHERIC WAVES

by K.C. Yeh and C.H. Liu

K.C. Yeh and C.H. Liu, Professors of electrical engineering, University of Illinois at Urbana-Champaign have written a good book entitled, "Theory of Ionospheric Waves." It is suitable as a textbook for a graduate course on the theory of ionospheric radio propagation and as a reference book for a graduate course on special topics such as waves in inhomogeneous, random and nonlinear media. This book is intended primarily for electrical engineering and applied physics students. It will appeal particularly to radio scientists and ionospheric physicists. To some extent, research workers will also find this book valuable to them. Simple and important theories in ionospheric wave propagation are presented clearly and completely. Basic theories are developed fully and are not crowded into insignificance by an excessive amount of charts of numerical results. Topics having a wide range of applicatons are treated. Since many important ideas in wave phenomena are developed using the ionosphere as a basis, the usefulness of this book may be reasonably expected to extend beyond those interested in ionospheric phenomena.

The book contains eight chapters and two appendices. Chapter 1 introduces the nature of the ionosphere and the ionospheric waves. Aspects of classical electromagnetic theory relevant to the study of ionospheric waves are reviewed in Chapter 2. Such topics as Kramers-Kronig relations, group and energy velocities and dyadic Green's functions are included. Waves in fluid plasma are treated in Chapter 3. Basic properties of plasmas such as plasma oscillations and Debye shielding, simple aspects of waves and instabilities in stationary and streaming plasmas and wave-particle interaction are all presented in a simple and clear manner. Waves in fluid plasma with a steady magnetic field is the subject of Chapter 4. Transient reflection from a plasma half space is treated, dielectric tensor for a cold magnetoplasma is derived and several of its important consequences are analyzed. Wave propagation parallel to the magnetic field, wave propagation perpendicular to the magnetic field, the Appleton-Hartree theory of waves in a magnetroionic medium and its extension to hydromagnetic frequencies are all examined carefully. Applications such as Faraday effect and Whistler phenomena are treated. Simple extension to warm magnetoplasma is presented. The language and the notation are clearly intended for ionospheric physicists.

Chapters 5,6 and 7 treating, respectively, wave propagation in inhomogeneous media, wave propagation in random media and nonlinear wave propagation are the important parts of this book. In these chapters, the treatment is introductory, the development is systematic and the presentation is reasonably complete. Ray theory for isotropic and anisotropic media, WKB and matrix methods, low and high frequency approximations to the reflection coefficient for a stratified media and the theory and application of Försterling's coupled equations to wave propagation in stratified magnetoplasma are discussed. Basic aspects of wave propagation in random media, scattering of electromagnetic waves by irregularities, geometrical and wave theories of fluctuations in random media and perturbation techniques are some of the topics contained in Chapter 6. In Chapter 7 the authors discuss breaking and self-interaction of waves, cross-modulation and wave-wave interaction and Whitham's averaged variational principle useful for the treatment of nonlinear wave problems.

The treatment of acoustic waves in gravitationally stratified atmosphere and the interaction of these acoustic-gravity waves with the ionosphere are contained in Chapter 8 which will be particularly useful to the atmospheric scientists. Two appendices, one on the method of steepest descents and the other on the far-zone field from a localized source conclude this book.

Problems are provided at the end of each chapter. Many of these problems are intended to extend the treatment contained in the text. At the end of several problems, the authors have thoughtfully provided references where interested readers may find assistance for the solutions of problems.

In summary, THEORY OF IONOSPHERIC WAVES by K.C. Yeh and C.H. Liu is a well-written book which is suitable as a textbook for a graduate course on the theory of ionospheric waves and as a reference book for a special topics course on waves in inhomogeneous, random and nonlinear media as well as for research workers in radio science and ionospheric physics.

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