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Discrete Oscillation Theory

Ravi P. Agarwal, Martin Bohner, Said R. Grace, and Donal O'Regan, Series Contemporary Mathematics and Its Applications, Volume 1, Hindawi Publishing Corporation, 2005, 961 pages, ISBN 977-5945-19-4

This monograph is the first volume of "Contemporary Mathematics and Its Applications", which is a book series of monographs and textbooks in all areas of pure and applied mathematics published by Hindawi Publ. Corp. This monograph is intended to offer a comprehensive introduction to the study of several modern problems in Mathematical Physics and Nonlinear Analysis by using some powerful and modern mathematics methods.

We distinguish 9 main parts of this monograph. Chapter 1 is devoted to a general presentation of oscillation theory for second order linear difference equations. There are mainly discussed oscillatory, nonoscillatory, as well as other qualitative properties of solutions. There are also developed some basic properties of important notions like Riccati's transformation, Picone's identity, Sturm comparison and separation theorem etc. Many of these results are extended in the next chapter of the book in the framework of symplectic difference systems. In particular, all the results developed in Chapter 2 remain true for Hamiltonian difference systems or Sturm-Liouville difference equations. In Chapter 3 there are presented both oscillation and nonoscillation criteria for second order half-linear difference equations. The main topics include: the disconjugacy characterization theorem (Reid roundabout theorem), Sturm-type comparison and separation theorems, variational principles, conjugacy criteria, existence of positive nondecreasing solutions of half-linear difference equations, and oscillation properties of discrete generalized Euler equations. In Chapters 4 and 5 the authors are concerned with oscillation, boundedness, and asymptotic properties of solutions to second order nonlinear difference equations. Damped nonlinear difference equations are considered as well. Chapter 6 is devoted to the qualitative analysis of the oscillatory behaviour of certain classes of difference equations with deviating arguments. There are established criteria for oscillation or almost oscillation for linear, nonlinear and half-linear difference equations. The main purpose of the next chapter is to investigate oscillation properties for neutral difference equations with or without forcing term. Chapter 8 deals with corresponding properties for differential equations with piecewise constant arguments. There are mainly discussed both second order equations and systems of alternately advanced and retarded type. These models have applications in control theory and biomathematics. In Chapter 9 there are discussed various interesting topics, including: existence and comparison properties of positive solutions of first order delay difference equations, oscillation criteria for neutral difference equations with periodic coefficients, linearized oscillations for autonomous and nonautonomous delay difference equations, as well as global asymptotic stability of various types of recursive sequences.

An excellent contribution to the mathematical literature of the discrete oscillation theory, this self-adjoint exposition offers a systematic examination and panoramic view of the topic. This book is a pleasure to read. It will be an excellent source, allowing the reader to build a proper intuition and to understand the basic facts of the theory. The level of mathematical knowledge required is elementary, so it should be very useful for students at undergraduate and graduate level, while researchers, physicists, engineers, biologists, may find the new concepts very motivating. As a conclusion, the reviewer considers that this volume is really first rate and the Publisher, Hindawi Publishing Corporation, has done a fine job.

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