

Agarwal, Ravi P.; O'Regan, Donal

Infinite interval problems for differential, difference and integral equations. (English)

Zbl 0988.34002

Dordrecht: Kluwer Academic Publishers. x, 341 p. (2001).

This nice monograph reflects mainly the authors' research over a period of more than ten years and offers various existence criteria for differential, difference and integral equations over the infinite interval. It consists of eight chapters dealing with different classes of equations, with almost self-contained exposition. Each chapter has a number of carefully selected examples that illustrate practically all the principal results and an extensive bibliography listing major contributions to the subject.

The following is a brief description of the monograph. Chapter 1 is concerned with the existence theory on several different types of second-order boundary value problems on infinite intervals. Both major approaches available in the literature for the study of infinite interval problems are presented. The first approach is based on a diagonalization process, whereas the second is based on the Furi-Pera fixed-point theorem. Chapter 2 establishes existence theory for higher-order differential equations together with conjugate and right focal type boundary data over the infinite interval. Chapter 3 deals with the existence theory for continuous systems over the infinite interval. For the linear problem, necessary and sufficient conditions for the existence of a solution are given, while for the nonlinear problem sufficient conditions are provided along with some iterative methods. Chapter 4 is devoted to the existence of solutions to integral equations of Volterra and Fredholm type over the infinite interval. The notions of collectively compact operators and strict convergence are introduced to establish the existence and approximation of solutions to some nonlinear operator equations on the infinite interval. Solution sets to abstract Volterra, functional and functional-differential equations in different spaces are discussed, and applications to integral and integro-differential equations and initial value problems are given. Finally, results that guarantee the existence of periodic and almost-periodic solutions to some nonlinear integral equations over the whole real line are presented. In Chapter 5, discrete analogues of several results established in earlier chapters are presented. An existence theory for summary discrete systems and nonlinear Urysohn-type discrete equations is also discussed. Chapter 6 presents general existence principles for nonlinear integral equations and their discrete analogues in real Banach spaces over the infinite interval. In Chapter 7, the existence of solutions to nonlinear integral inclusions is discussed, and the topological structure of the solution set of Volterra integral inclusions is studied. Furthermore, existence criteria for Fredholm integral inclusions are presented, and the existence theory for abstract operator inclusions is addressed. Finally, Chapter 8 is concerned with the existence theory for second-order time scale boundary value problems over the infinite interval.

The monograph is well written and will be of interest for mathematicians and graduate students with research interest in applied mathematics.

Reviewer: [Yuri V.Rogovchenko \(Famagusta\)](#)

MSC:

- [34-02](#) Research exposition (monographs, survey articles) pertaining to ordinary differential equations
- [34G25](#) Evolution inclusions
- [45-02](#) Research exposition (monographs, survey articles) pertaining to integral equations
- [34Bxx](#) Boundary value problems for ordinary differential equations
- [39A12](#) Discrete version of topics in analysis
- [34C25](#) Periodic solutions to ordinary differential equations
- [34C27](#) Almost and pseudo-almost periodic solutions to ordinary differential equations

Cited in **2** Reviews
Cited in **129** Documents

Keywords:

existence; boundary value problems; infinite interval; difference equations; integro-differential equations; integral equations; operator inclusions