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Nonlinear Differential Equations and Dynamical Systems

By Verhulst, Ferdinand

Book Condition: New. Publisher/Verlag: Springer, Berlin | This book bridges the gap between elementary courses and the research literature. The basic concepts necessary to study differential equations - critical points and equilibrium, periodic solutions, invariant sets and invariant manifolds - are discussed. Stability theory is developed starting with linearisation methods going back to Lyapunov and Poincaré. The global direct method is then discussed. To obtain more quantitative information the Poincaré-Lindstedt method is introduced to approximate periodic solutions while at the same time proving existence by the implicit function theorem. The method of averaging is introduced as a general approximation-normalisation method. The last four chapters introduce the relaxation oscillations, bifurcation theory, centre manifolds, chaos in mappings and differential equations, Hamiltonian systems (recurrence, invariant tori, periodic solutions). | 1 Introduction.- 1.1 Definitions and notation.- 1.2 Existence and uniqueness.- 1.3 Gronwall's inequality.- 2 Autonomous equations.- 2.1 Phase-space, orbits.- 2.2 Critical points and linearisation.- 2.3 Periodic solutions.- 2.4 First integrals and integral manifolds.- 2.5 Evolution of a volume element, Liouville's theorem.- 2.6 Exercises.- 3 Critical points.- 3.1 Two-dimensional linear systems.- 3.2 Remarks on three-dimensional linear systems.- 3.3 Critical points of nonlinear equations.- 3.4 Exercises.- 4 Periodic solutions.- 4.1 Bendixson's criterion.- 4.2 Geometric auxiliaries, preparation for...

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