

## Nonlinear Differential Equations and Dynamical Systems

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## NONLINEAR DIFFERENTIAL EQUATIONS AND DYNAMICAL SYSTEMS



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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 Poincar. The global direct method is then discussed. To obtain more quantitative information the Poincar -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 the Poincaré-Bendixson theorem.- 4.3 The Poincaré-Bendixson theorem.- 4.4 Applications of the Poincaré-Bendixson theorem.- 4.5 Periodic solutions in ?n.- 4.6 Exercises.- 5 Introduction to the theory of stability.- 5.1 Simple examples.- 5.2 Stability of equilibrium solutions.- 5.3 Stability of periodic solutions.- 5.4 Linearisation.- 5.5 Exercises.- 6 Linear Equations.- 6.1 Equations with constant coefficients.- 6.2 Equations with coefficients which have a limit.- 6.3 Equations with periodic coefficients.- 6.4 Exercises.- 7 Stability by linearisation.- 7.1 Asymptotic stability of the trivial solution.- 7.2 Instability of the trivial solution.- 7.3 Stability of periodic solutions of autonomous equations.- 7.4 Exercises.- 8 Stability analysis by the direct...

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