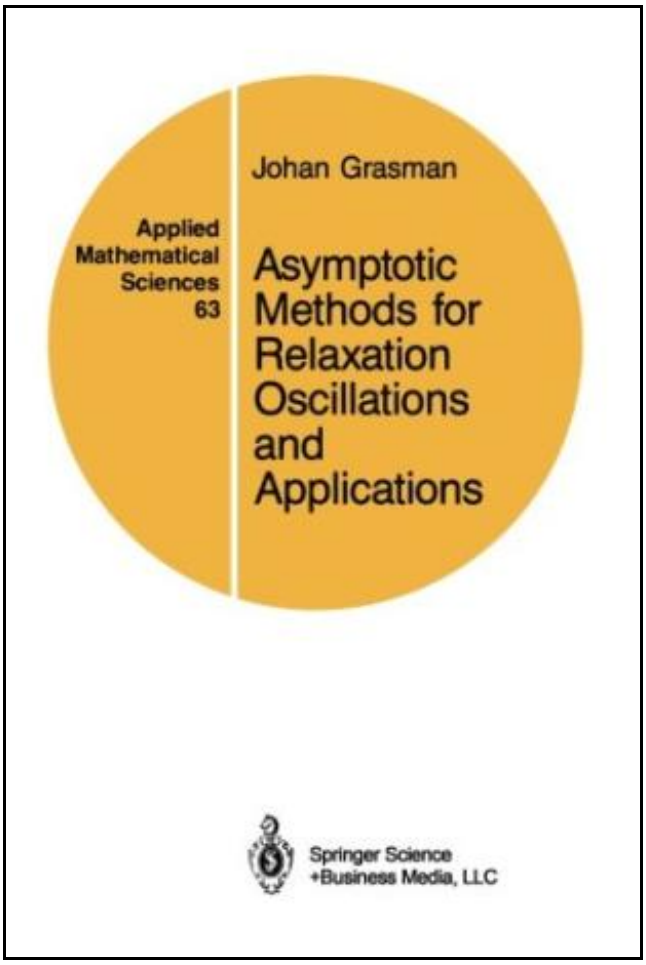
Asymptotic Methods for Relaxation Oscillations and Applications



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Book Condition: New. Publisher/Verlag: Springer, Berlin | In various fields of science, notably in physics and biology, one is con fronted with periodic phenomena having a remarkable temporal structure: it is as if certain systems are periodically reset in an initial state. A paper of Van der Pol in the Philosophical Magazine of 1926 started up the investigation of this highly nonlinear type of oscillation for which Van der Pol coined the name "relaxation oscillation". The study of relaxation oscillations requires a mathematical analysis which differs strongly from the well-known theory of almost linear oscillations. In this monograph the method of matched asymptotic expansions is employed to approximate the periodic orbit of a relaxation oscillator. As an introduction, in chapter 2 the asymptotic analysis of Van der Pol's equation is carried out in all detail. The problem exhibits all features characteristic for a relaxation oscillation. From this case study one may learn how to handle other or more generally formulated relaxation oscillations. In the survey special attention is given to biological and chemical relaxation oscillators. In chapter 2 a general definition of a relaxation oscillation is formulated. | 1. Introduction.- 1.1 The Van der Pol oscillator.- 1.2 Mechanical prototypes of relaxation oscillators.- 1.3 Relaxation oscillations in physics and biology.- 1.4 Discontinuous approximations.- 1.5 Matched asymptotic expansions.- 1.6 Forced oscillations.- 1.7 Mutual entrainment.- 2 Free oscillation.- 2.1 Autonomous relaxation oscillation: definition and existence.- 2.1.1 A mathematical characterization of relaxation oscillations.- 2.1.2 Application of the Poincaré-Bendixson theorem.- 2.1.3 Application of the extension theorem.- 2.1.4 Application of Tikhonov's theorem.- 2.1.5 The analytical method of Cartwright.- 2.2 Asymptotic solution of the Van der Pol equation.- 2.2.1 The physical plane.- 2.2.2 The phase plane.- 2.2.3 The Lienard plane.- 2.2.4 Approximations of amplitude and period.- 2.3 The Volterra-Lotka equations.- 2.3.1 Modeling prey-predator systems.- 2.3.2 Oscillations with...

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