

Contents

Preface	ix
Chapter 1. Classical two-dimensional oscillating systems and their multidimensional analogues	1
§1.1. The van der Pol equation	1
§1.2. The equation of oscillations of a pendulum	6
§1.3. Oscillations in two-dimensional systems with hysteresis	22
§1.4. Lower estimates of the number of cycles of a two-dimensional system	27
Chapter 2. Frequency criteria for stability and properties of solutions of special matrix inequalities	34
§2.1. Frequency criteria for stability and dichotomy	34
§2.2. Theorems on solvability and properties of special matrix inequalities	46
Chapter 3. Multidimensional analogues of the van der Pol equation .	52
§3.1. Dissipative systems. Frequency criteria for dissipativity	52
§3.2. Second-order systems. Frequency realization of the annulus principle	70
§3.3. Third-order systems. The torus principle	80
§3.4. The main ideas of applying frequency methods for multidimensional systems	89
§3.5. The criterion for the existence of a periodic solution in a system with tachometric feedback	94
§3.6. The method of transition into the "space of derivatives"	97
§3.7. A positively invariant torus and the function "quadratic form plus integral of nonlinearity"	111
§3.8. The generalized Poincaré-Bendixson principle	119
§3.9. A frequency realization of the generalized Poincaré-Bendixson principle	123
§3.10. Frequency estimates of the period of a cycle	126

Chapter 4. Yakubovich auto-oscillation	129
§4.1. Frequency criteria for oscillation of systems with one differentiable nonlinearity	130
§4.2. Examples of oscillatory systems	142
Chapter 5. Cycles in systems with cylindrical phase space	148
§5.1. The simplest case of application of the nonlocal reduction method for the equation of a synchronous machine	149
§5.2. Circular motions and cycles of the second kind in systems with one nonlinearity	152
§5.3. The method of systems of comparison	169
§5.4. Examples	171
§5.5. Frequency criteria for the existence of cycles of the second kind in systems with several nonlinearities	180
§5.6. Estimation of the period of cycles of the second kind	196
Chapter 6. The Barbashin-Ezeilo problem	202
§6.1. The existence of cycles of the second kind	204
§6.2. Bakaev stability. The method of invariant conical grids ...	218
§6.3. The existence of cycles of the first kind in phase systems ..	231
§6.4. A criterion for the existence of nontrivial periodic solutions of a third-order nonlinear system	239
Chapter 7. Oscillations in systems satisfying generalized Routh-Hurwitz conditions. Aizerman conjecture	249
§7.1. The existence of periodic solutions of systems with nonlinearity from a Hurwitzian sector	251
§7.2. Necessary conditions for global stability in the critical case of two zero roots	271
§7.3. Lemmas on estimates of solutions in the critical case of one zero root	277
§7.4. Necessary conditions for absolute stability of nonautonomous systems	280
§7.5. The existence of oscillatory and periodic solutions of systems with hysteretic nonlinearities	289

Chapter 8. Frequency estimates of the Hausdorff dimension of attractors and orbital stability of cycles	304
§8.1. Upper estimates of the Hausdorff measure of compact sets under differentiable mappings	304
§8.2. Estimate of the Hausdorff dimension of attractors of systems of differential equations	310
§8.3. Global asymptotic stability of autonomous systems	318
§8.4. Zhukovsky stability of trajectories	322
§8.5. A frequency criterion for Poincaré stability of cycles of the second kind	345
§8.6. Frequency estimates for the Hausdorff dimension and conditions for global asymptotic stability	349
Bibliography	377
Subject index	401